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CASE REPORT

Veneers on Devitalized Teeth: The Role of Adhesive Dentistry in Aesthetic and Functional Therapies

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ABSTRACT
Devitalized teeth present a unique challenge in aesthetic dentistry, often exhibiting aesthetic issues such as color variations, shape changes, or structural fragility. In response to these challenges, dental veneers emerge as a promising solution to restore both the aesthetics and functionality of devitalized teeth. While chemical teeth whitening is the primary treatment approach for dental discolorations, some prove resistant, occasionally necessitating prosthetic interventions. This article aims to explore the application of ceramic veneers as an aesthetic and conservative solution to address the challenges associated with devitalized teeth. We will delve into the procedural steps, technological advancements, and clinical considerations guiding this contemporary practice in aesthetic dentistry.
KEYWORDS: devitalized teeth, dental veneers, esthetics, ceramic.

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INTRODUCTION

The adoption of ceramic veneers on devitalized teeth is a less common clinical procedure, but it is gaining popularity in aesthetic dentistry [1]. This approach becomes particularly pertinent due to the aesthetic hurdles frequently encountered with devitalized teeth, such as color and shape changes over time [2,3]. Ceramic veneers emerge as a promising aesthetic solution, offering the advantage of conserving more dental structure than full coverage restorations [1,4,5]. Moreover, the emergence of resilient ceramics, coupled with an enhanced understanding of the biomechanical principles of teeth, propels us to expand the therapeutic indications for veneers continually [1,5,6]. When the proposed restoration adheres to the biomimetic principles of dental organ reconstruction, it becomes justified to seek the least invasive technical solution [6]. This is especially applicable to devitalized teeth with minimal peripheral damage, which can significantly benefit from restoration using bonded ceramic veneers [1]. Technological advancements and ongoing research in aesthetic dentistry provide exciting prospects to enhance the performance of dental veneers. However, a comprehensive assessment of each case, considering aesthetic, functional, and anatomical aspects, remains fundamental to ensuring the longevity of the restoration and, consequently, patient satisfaction [1,5,6]. This article examines the application of ceramic veneers as a conservative and aesthetic solution for addressing issues related to devitalized teeth. Thus, this study delves into the procedural steps, technological advancements, and clinical considerations that support this contemporary approach in aesthetic dentistry.

CLINICAL CASE

Clinical Examination

A 23-year-old patient (Figures 1 and 2) presented at the Prosthodontic Department at the Dental Consultation and Treatment Center in Rabat due to severe discoloration of tooth 21 (Figure 1). The patient reported that he had undergone endodontic treatment on the tooth due to a trauma that occurred two years ago. The patient's general medical history and extraoral examination showed no particularities. The smile examination revealed limited visibility of the periodontium with an average smile line. Clinically, there was evidence of substance loss at the incisal angle due to both traumatic and therapeutic reasons related to the access cavity for the endodontic treatment. Radiological examination facilitated the assessment of overall tissue loss and the quality of the endodontic treatment, which was deemed unsatisfactory (Figure 2).

Treatment Plan

Due to the limited coronal damage on tooth 21 and the notable dental discoloration observed, the preferred treatment plan involves endodontic retreatment and implementing internal bleaching as a preprosthetic therapeutic measure, which will be followed by coronal restoration using a full zirconia veneer.

Figures 1 and 2: Initial state.

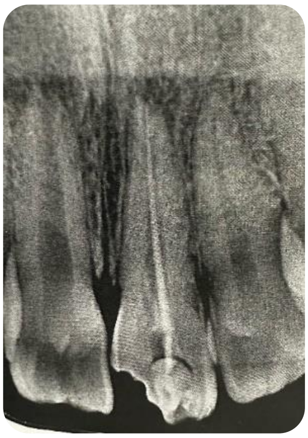

Figure 3: Radiograph of initial state.

Clinical Protocol

Endodontic Retreatment

The protocol entails removing all canal obturation materials from the endodontic system and reperforming cleaning, shaping, and obturation of the canal in a hermetic three-dimensional manner. The primary directive is to "aim for improvement" while being particularly cautious not to "exacerbate the situation" (Figure 4).

Internal Bleaching

All bleaching methods rely on the principle of the chemical breakdown of hydrogen peroxide molecules into nascent oxygen, capable of eliminating the main color agents. Lightening the substrate makes the procedure more manageable for the prosthetist, and material choices can lean toward more translucent solutions, thereby providing a more natural result (Figure 5).

Figure 4: Revision of the endodontic treatment on tooth 21

Figure 5: Result after internal bleaching of tooth 21

Preparation

The current approach involves using the final morphology of the restoration as a reference for the preparation shape. This morphology is developed in the form of a provisional wax-up that aligns with the aesthetic plan (Figure 6). The study model modified by this wax-up serves as the foundation for creating silicone keys, enabling the fabrication of the esthetic mask (Figure 7) and guiding the preparation.

Figure 6: Wax-up.

Figure 7: Mockup on tooth 21.

The preparation begins with a depth cutter bur. Two horizontal grooves, 0.4 mm deep, are prepared (Figure 8) [14]. These grooves are made to respect the convexity of the tooth. The preparation continues with the cervical limit, which is achieved using a fine-diameter round bur, with the mandrel applied against the vestibular face. This round bur precisely establishes the cervical limit while maintaining very shallow depths in this area where enamel thickness is the lowest. Due to the significant dental discoloration, the cervical limit has been slightly submerged at the intrasulcular level.

Figure 8: Creation of horizontal grooves.

To better visualize the depth of the preparation, the bottom of each groove can be outlined with a pencil before removing the mask (Figure 8). Reduction of the involved tooth continues with a chamfer bur, allowing the elimination of persistent enamel substitute between the previously made grooves.

The proximal limit area is crucial as it determines the nonvisibility of the restoration in lateral view. Below the contact surface, the limit is marked as close to the interdental papillae as possible by creating a gingival-proximal extension.

The reduction of the free edge, with a 2 mm thickness, and the preparation of the palatal return are achieved using a chamfer bur. Special attention is given to the placement of the palatal return, aiming to avoid the most concave area of the palatal surface, which is prone to significant mechanical stress and an increased risk of fracture. The use of the reduction key also guides and controls our preparation (Figures 9 and 10).

Figure 9: Control of the preparation from occlusal view.

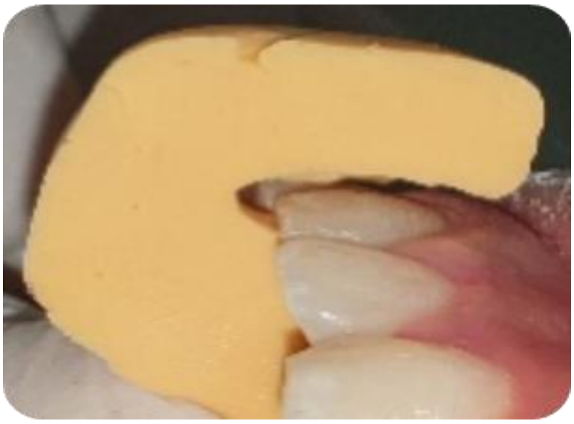

Figure 10: Control of the preparation from the proximal view.

Impression and Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM)

The impression is taken using Silicone A, with the double-mix technique to accurately capture the cervical limit intrasulcularly. After disinfection, the impression is digitally recorded directly using a tabletop scanner (extraoral).

Figure 11: Final preparation.

Prosthetic design begins with tracing the finish line and selecting the insertion axis. Then, a virtual wax-up is generated using a database of dental morphologies (Figure 12), considering imposed criteria (e.g., minimum material thickness, cervical limit, and antagonist). This is followed by the computer-aided manufacturing (CAM) step, which has enabled the production of the entire prosthetic piece in full zirconia 5Y TZP (Figure 13).

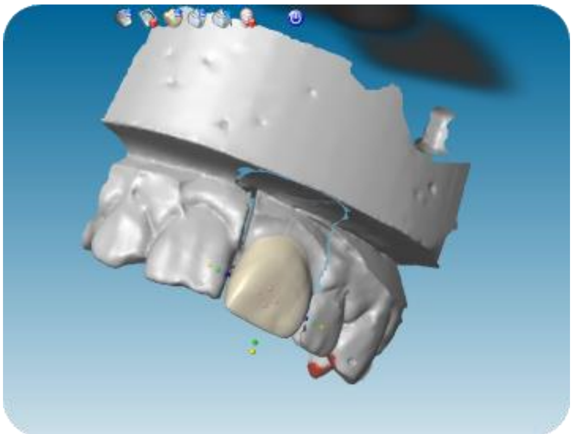

Figure 12: Virtual modelling.

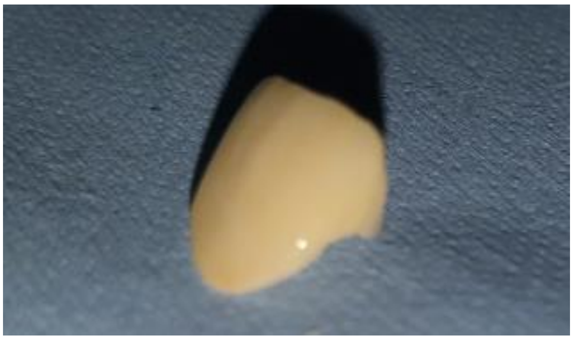

Figure 13: Prosthetic piece fabrication.

Try-in and Bonding

Once the adaptation, occlusion, and aesthetic aspects have been approved, the bonding of the veneer can be considered. The shade of the resin cement was selected using PANAVIA™ V5 Try-in pastes.

The chosen bonding protocol was based on the APC concept. The APC concept is detailed in the following three steps:

1. Step A involves air-abrading the entire surface of the zirconia to be bonded. It is done using either simple alumina particles or alumina particles coated with silica.
2. Step P involves the application of a special zirconia primer containing phosphate monomers.
3. Step C involves the use of a dual-cure adhesive composite to ensure adequate polymerization of the composite under the zirconia restoration.

Thus, veneer bonding is conducted after the placement of a rubber dam and etching of the prepared tooth surface. The bonding agent (Panavia F 2.0) is applied to the veneer's intrados and on the tooth surface to avoid bubbles. A pre-polymerization is performed to facilitate excess removal. Subsequently, each surface is polymerized for 20 seconds. Before a new polymerization cycle, a glycerin gel is applied to the margins. Indeed, during open-air curing, a layer approximately 50 micrometers thick does not polymerize due to contact with oxygen. The glycerin gel covers this inhibition layer, allowing for more complete polymerization.

Figure 14: Final result.

DISCUSSION

The creation of dental veneers for devitalized teeth is a less common clinical procedure [7]. Devitalized teeth typically change color or shape over time. Currently, with advancements in preparation techniques and dental ceramics, dental veneers emerge as an aesthetic solution to address discolorations in devitalized teeth. They provide an alternative to full-coverage restorations, avoiding aggressive preparation of the palatal surface and preserving the dental structure [1,8]. Among the crucial criteria for the long-term success of veneers is the presence of significant bonding support.

A longitudinal study conducted by Maciej et al. assessed the clinical performance of ceramic veneers on both vital and nonvital teeth. The qualitative evaluation demonstrated acceptable results for all restorations, although a ceramic veneer bonded to a vital tooth failed due to secondary caries. Overall, the survival rate of these restorations reached 97.9% after eight years of clinical performance [8]. This result aligns with that of other studies reporting survival rates ranging from 91% to 100% [9,10].

Preserving the residual dental structure is crucial when preparing veneers for devitalized teeth. Minimizing dental substance loss while achieving aesthetic and functional goals is a delicate balance that dentists aim to achieve. Various studies in the literature discussed the impact of preparation design on the survival rate of ceramic veneers. Although findings differ across studies, it appears that a palatal return preparation offers superior support for the restoration, distributing occlusal forces more effectively.

In the case of fenestrated dental veneers, occlusal stresses tend to concentrate on the incisal third, increasing the risk of restoration fractures. Additionally, reducing the incisal edge can enhance incisal translucency [11-14].

Various ceramic materials are recommended for veneer fabrication, including lithium disilicate, feldspathic ceramic, feldspathic ceramic reinforced with leucite, and lithium silicate reinforced with zirconia [15-18]. These ceramics exhibit high translucency due to their high glass matrix content, providing satisfactory aesthetics. They also demonstrate excellent bonding to the adhesive product through hydrofluoric acid (4%–10%) conditioning followed by silanization [19]. For these reasons, these ceramics were chosen for veneer production [19]. However, these ceramics have certain limitations, especially in terms of their limited ability to mask significant dental discolorations and increased fragility in reduced thicknesses [17].

Conversely, ceramics with high crystalline content, such as yttria-stabilized tetragonal zirconia polycrystals (Y-TZP), were initially considered only for framework fabrication due to their high fracture resistance and ability to mask substrate discolorations [19]. However, recently, zirconia ceramics have undergone significant changes in their microstructure and composition [20] to increase translucency without significantly compromising mechanical properties, expanding their clinical indications. Therefore, translucent zirconia is currently considered an aesthetic material suitable for crafting monolithic crowns, both anterior and posterior, as well as fixed prostheses, including veneers and ultrathin veneers [21]. Its primary challenge arises in situations with low mechanical retention of the preparation, given that polycrystalline zirconia is chemically inert and not susceptible to attack by hydrofluoric acid (4%–10%), leading to less effective adhesion compared to silica-based ceramics [21]. Previous studies reported instances of detachment of zirconia restorations [22]. Consequently, various surface treatments have been proposed to alter the zirconia surface and enhance adhesion to resin cement. These include alumina sandblasting followed by MDP application or the implementation of a tribochemical treatment followed by silane application. [23].

The decision to opt for zirconia veneers in this clinical case stems from several considerations. Firstly, zirconia is renowned for its exceptional strength, providing a durable solution for dental restorations. In this context, where devitalized teeth often pose an increased risk of fracture, zirconia emerges as a prudent choice to ensure the longevity of the veneers. Additionally, zirconia offers an excellent ability to mask underlying discolorations, thereby providing an optimal aesthetic outcome. Overall, the selection of zirconia for the veneers in this clinical case is the result of a thorough assessment of the patient's specific needs, aiming to provide a durable, aesthetic, and functional solution.

However, despite the advancements in zirconia ceramics, they are not without limitations. Zirconia veneers pose challenges related to their limited ability to adhere effectively to tooth structure, especially in situations with low mechanical retention. Unlike silica-based ceramics, zirconia is chemically inert and less susceptible to bonding with resin cement, which may result in compromised adhesive strength and increased risk of debonding. Moreover, while translucent zirconia has been developed to enhance aesthetic outcomes, it may still exhibit lower translucency than other ceramic materials, potentially compromising the natural appearance of the restoration [18-22].

CONCLUSION

The application of dental veneers on devitalized teeth requires a meticulous and personalized approach. Maximizing the preservation of the remaining dental structure, particularly the enamel, is crucial to ensuring durable adhesion. Ongoing technological advancements and research in the field of aesthetic dentistry offer exciting opportunities to enhance the performance of dental veneers further. However, a thorough evaluation of each case, considering aesthetic, functional, and anatomical aspects, remains fundamental to ensure the longevity of the restoration and, consequently, patient satisfaction. Close collaboration between the practitioner, dental prosthetist, and the patient is essential to define realistic expectations and achieve a balance between aesthetics and tissue preservation.

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AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction and the revision of the manuscript and provided approval for this final revised version.

COMPETING INTERESTS

The authors declare no competing interests in this case.

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